However, the main problem with the collection is that few of the papers refer to modern ideas in glacial geomorphology, and few suggest how the till is deposited (understanding of which is vital to explaining the transport of erratics). Two notable exceptions are the papers by Martin Rappol, on the processes of sedimentation, and Peter Bobrowsky, on lithological analysis. Most of the papers are written by authors who have worked in applied aspects of glacial geomorphology (without a modern analogue and/or process experience base). There is therefore clearly a need for more links between pure and applied researchers in glacial geomorphology.

My final query relates to the time and money (apparent from the expensive excavating tools) being spent on drift prospecting. Can data from these sections be used to increase our knowledge of glacial sedimentary processes (with the results being published elsewhere), or is drift prospecting an end in itself? What effect does this prospecting have on the environment? Only one of the papers (by Alan Plouffe) addresses these issues, in the sense that the damage to the environment was a factor to be considered when choosing a site to investigate.

In conclusion, this is an interesting collection of papers about drift prospecting, which would be directly useful for applied geomorphologists. Many of the discussed techniques could be used by both pure and applied researchers. Students will also find it informative, and I therefore suggest that it is a useful addition to any academic library.

JANE K. HART
Department of Geography
University of Southampton, UK

HORACE-BENEDICT DE SAUSSURE, FORERUNNER IN GLACIOLOGY by A. V. Carozzi and J. K. Newman, Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, Volume 48, Editions Passé Présent, Geneva, 1995. No. of pages: xii + 149. ISSN 0252-7960.

The subtitle of this book explains its content and purpose: 'New manuscript evidence on the earliest explorations of the glaciers of Chamonix and the fundamental contribution of Horace-Benedict de Saussure to the study of glaciers between 1760 and 1792'. It presents painstaking archival research that throws light on the early development of glaciology. French and Latin sources are given in the original and in translation, and de Saussure's manuscript notebooks are mined for references to glaciological phenomena. De Saussure is shown to have anticipated concepts of firnification and subglacial hydrology, and in the face of opposing views, to have understood that glaciers move down-valley as upglacier ice replaces that which melts downglacier. He introduced terms such as *sérac*, *moraine*, *roche moutonné*. There is also much here that illustrates the early development of methodology in this science. Having visited Chamonix briefly in 1760 and 1761, de Saussure systematically planned a research visit in 1764, and his notebooks reveal a list of 15 broad objectives focusing on the nature of the glacier, its shape and position, its size, and related observations. It is evident that he was not merely gathering data; he was theorizing and testing hypotheses. Why else would he wish to 'observe if the snow is not arranged in layers or in thin sheets and what is the direction of these layers'? His subsequent observations of meltwater streams issuing from glaciers, and of the ploughing action of glaciers building what are now referred to as push moraines, confirmed his view of glaciers as sliding down-valley on a sheet of water, and he interpreted glacier motion in terms of a balance between gains and losses a century before G. K. Gilbert's supposedly seminal introduction to the Earth sciences of equilibrium concepts. He was also conscious of environmental change, but aware that some glaciers were advancing while others retreated. There are many moments to savour in browsing through this book for anyone interested in the history of glacial studies and of Earth science.

KEITH RICHARDS
University of Cambridge

CLAY AND SHALE SLOPE INSTABILITY edited by William C. Haneberg and Scott A. Anderson, GSA Reviews in Engineering Geology Series, The Geological Society of America, Boulder, Colorado, 1995. No. of pages: v + 158. Price: $60.00 (hb). ISBN 0-8137-4110-6.

This collection of papers arises from a symposium of the Engineering Geology Division of the Geological Society of America, held in 1992. The broad aim of the volume, as with other recent *Reviews in Engineering Geology* on neotectonics in earthquake evaluation (Krinitzsky and Slemmons, 1990) and landslide mitigation (Slossen *et al*., 1992), is to provide state-of-the-art information on a particular subject area, in this instance clay and shale hillslope processes. Three of the chapters are based on symposium talks, with seven post-symposium contributions. The papers are diverse in content. Some describe qualitative and other quantitative studies; some are based on field testing and others laboratory analysis; two focus on modelling.

Although the topics are varied, four broad themes emerge from the book. The first is field studies of instability and landslide movement. Baum and Reid (Chapter 6) examine the geology, hydrology and mechanics of a slow-moving, clay-rich landslide in Honolulu, concluding that movement activity is related to the duration and frequency of rainfall events and consequent changes in pore-water pressure. Bertocci *et al*. (Chapter 7) deal with landslides on clay and shale hillslopes in Tuscany, Italy. Results suggest that for shorter mudslides on gentler slopes instability is a consequence of undrained loading, while for larger features palaeoclimatic factors may have to be taken into account. The

second theme is laboratory studies. Both Anderson and Sitar (Chapter 1), in examining variations of measured strength parameters for the same material using different test regimes, and Watry and Ehlig (Chapter 2), in determining the best laboratory method for establishing the residual factor of safety, conclude that sample preparation and test conditions can result in big differences in measured material properties rather than variations being a true reflection of field conditions. Wong *et al*. (Chapter 3) use the triaxal test to determine viscoplastic soil parameters required for the application of Iversons's (1985) viscoplastic constitutive model.

There are three chapters which focus on the weathering of argillaceous materials and implications for slope stability. Dick and Shakoor (Chapter 8) consider mudrock durability and relationships between durability and mass movement type. Shakoor (Chapter 9) examines failures where undercutting has resulted from the differential weathering of two juxtaposed strata. Watters and Delahaut (Chapter 10) examine the argillic alteration which accompanies hot, hydrothermal fluids and the consequent reduction in rock mass strength. Finally, there are two papers which develop modelling themes. Michaelowski (Chapter 4) suggests that the limit analysis approach to determining slope instability makes less arbitrary static assumptions than alternative approaches – such as the inclination of forces between slices in limit equilibrium methods – and is therefore more accurate. The second, by Haneberg (Chapter 5), reports the effects of steady groundwater on the stability of heterogeneous infinite slopes underlain by impervious strata.

The contents of the volume are varied in their appeal to geomorphologists. Some sections are of general interest, examples being the evaluation of viscoplastic slope movements (Chapter 3) and examination of the geology, hydrology and mechanics of a slow-moving, clay-rich landslide in Honolulu (Chapter 6). Others are less significant where, for example, the data focus on a specific site for engineering purposes. The volume is well produced; tables and figures are on the whole clear and relevant. In summary, this is a volume with contributions of interest to geomorphologists. For those with slope stability research interests in soft earth materials a foray into the text, even if only briefly, will be time well spent during a visit to the library and will probably suffice, rather than calling at the book shop to place an order.

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ROBERT J. ALLISON
Department of Geography
University of Durham, UK

MATERIAL FLUXES ON THE SURFACE OF THE EARTH edited for the National Research Council, National Academy Press, Washington, 1994. No. of pages: xiv + 170. Price: £32.95. ISBN 0-309-04745-5.

VARIABILITY IN STREAM EROSION AND SEDIMENT TRANSPORT edited by L. J. Olive, R. J. Loughran and J. A. Kesby, International Association of Hydrological Sciences Publication No. 224, IAHS Press, Wallingford, 1994. No. of pages: x + 498. Price: £75.00. ISBN 0-947571-19-1.

These volumes provide very different perspectives on the transport of materials at the surface of the Earth and have been published in response to different aims and objectives. *Material Fluxes on the Surface of the Earth* (*Material Fluxes*) is the 19th in a series of *Studies in Geophysics* published since 1977 to provide a source of information to assist policy-makers in decision-making, and to assess emerging research topics in geophysics. By contrast, *Variability in Stream Erosion and Sediment Transport* (*Variability in Erosion*) is the latest conference publication emanating from the International Committee on Continental Erosion of the International Association of Hydrological Sciences. This conference theme was chosen to focus on the role of variability in erosion and sediment transport and especially in the establishment of adequate research and monitoring designs.

Through ten review chapters and an overview, *Material Fluxes* publishes a report of the Board on Earth Sciences and Resources to the US National Research Council. The purpose of the report was: (1) to provide an overview of the state of knowledge on modern and late Pleistocene material fluxes; (2) to evaluate the variability in process rates over the same time scale; (3) to assess the extent to which measurement of modern fluxes incorporates an estimate of anthropogenic impact; (4) to identify the variability of process rates in terms of changing and fluctuating rates over different time scales; (5) to disclose important gaps in existing material flux estimates; and (6) to suggest how knowledge of natural variability may be incorporated into models of future change. It was with considerable optimism that I began reading this report, and this was stimulated by a well-written overview which attempted to synthesize the main body of the report in order to meet these six objectives. Whilst it was somewhat disturbing to be presented with unequivocal evidence that the current state of knowledge of global fluxes of most materials is poor, this chapter identified a number of critical knowledge gaps which need to be filled by scientific research. However, I was disappointed by the lack of a global reseach strategy and conceptual/methodological framework for estimating the critical fluxes and filling the gaps identified. The conventional organization and structure given to many of these ten chapters is also disappointing. It has long been recognized that the division between chemical and particulate fluxes is essentially artificial, particularly in